Copy of record of work with boric acid and oranges in the United States Department of Agriculture as certified to American Fruit Growers Incorporated by R. W. Dunlap, Acting Secretary of Agriculture, under date of January 18, 1927, *together with copies of additional records showing further work upon the same subject and United States Department of Agriculture correspondence with reference thereto.*

Extract from printed transcript of record in case of American Fruit Growers Inc., Petitioner, v. Brogdex Company, No. 48 October Term, 1930, Supreme Court of the United States, Vol. II, pages 1475-1480:

Defendant's Exhibit No. 9.

Department of Agriculture, Washington

January 18, 1927.

Pursuant to Section 882 of the Revised Statutes of the United States, I hereby certify that the following and annexed eight sheets are true, correct and compared photostat copies of the original records, on file in the United States Department of Agriculture, at Washington, D. C., of experiments with boric acid and oranges, conducted in the Bureau of Plant Industry of the Department of Agriculture.

Witness my hand and seal of the United States Department of Agriculture.

R. W. DUNLAP,
Acting Secretary of Agriculture.

[SEAL]

BORIC ACID AND ORANGES.

First Experiments.

Reported by H. C. Gore in collaboration with W. M. Scott.

Experiments with Boric Acid and oranges, stated December 19, 1904. Four sound oranges (seeded Florida oranges) were inoculated in three places on each fruit, with a pure culture of penicillium glaucum. The abrasions into which the spores were inoculated were of three different kinds, all three kinds being used on each fruit. The kinds of abrasions made were as follows: a round hole about three m. m. in diameter, a stub, the blade of the scalpel being slightly twisted before withdrawal, and a cut made so as to remove a thin slice of the epidermis. In the photograph accompanying this report only the first kind of inoculation is shown. The four fruits were then numbered and treated as below, and then placed under a large glass bell jar on a ground glass plate, this arrangement serving as a moist chamber.

Fruit No. 1, not treated, used as control.

Fruit No. 2, powdered boric acid was gently rubbed into the abraded parts of the skin.

Fruit No. 3, dipped in a saturated solution of pure boric acid.

Fruit No. 4, abraded parts of skin bathed with a saturated solution of pure boric acid.

Results of above experiments.
(5 days later).

On December 24th it was noted that fruit No. 1 showed patches of green mold at each of the three points of inoculation. Nos. 2, 3 and 4 showed no

change. By December 27th these patches on fruit No. 1 had grown larger, the other fruits being not affected. On Wednesday December 28th fruit No. 1 was well advanced in decay, while fruits Nos. 2, 3 and 4 were unaffected except No. 2, in which the area about the inoculated points was a little shrunken. Decay may be setting in here. At this time the four fruits were photographed. On December 30th No. 1 was nearly covered with green mold, but no further change was noticed in other specimens. On December 31st, however, Nos. 2 3 and 4 showed unmistakable evidence of the development of the fungus. No. 2 showed softening at all three points of inoculation. Nos. 3 and 4 showed softening at two inoculation points on each fruit. In both of these the stab form of inoculation has not started to go down (this form of inoculation being most protected from extraneous spores.) For this reason, and also because the four fruits were kept together under the same bell jar during the time in which No. 1 was developing fungus spores in great abundance, it is believed that the decay noted in Nos. 2, 3 and 4 caused by a second inoculation of spores which came from fruit No. 1.

FINAL RESUTS WITH EXPERIMENT SERIES I C.

First treated by the Baker process, and kept under bell-jar until January 3.

Eleven fruits were removed to mailing boxes on January 3rd, 1905. After six days, 17 of the 22 inoculations had softened down. No permanent check of the growth of the fungus is therefore shown.

Exp. 1 Baker process. Duplicate of Exp. 1 Ser. 1 I C. Started January 3, 1905.

On January 5. No changes.

On January 9. A very slight development of the fungus was noted at five of the inoculated places, the exposed white surface of the rind showed development of white mycelia and green spores of mold, but the orange was not attacked in the usual manner by the mold.

Exp. 3. Control of Exp. 1,—also control of Exp. 2. Stated January 3.

On January 9. A very slight development of the fungus was noted at 14 of the inoculation places, the exposed white surface of the rind showed development of white mycelia and green spores of the mold, but the orange was not attacked in the usual way by the fungus.

Exp. 2. ½ minute dip in saturated boric acid solution. Kept in air tight bell jar. Started January 3.

On January 6. No change.

On January 9. No change.

Exp. 4. ½ minute dip in ½ saturated boric acid solution. Kept in moist chamber. Started January 3.

On January 6. 1 inoculated place had softened.

On January 7. 3 inoculated places had softened.

On January 9. 7 inoculated places had softened, of which 6 had fruited.

Exp. 5. ½ minute dip in ¼ saturated boric acid solution. Kept in moist chamber. Started January 3.

On January 6. No inoculated places had softened.

On January 7. 4 inoculated places had softened.

On January 9. 11 inoculated places had softened, of which 8 are fruited.

Exp. 6. ½ minute dip in ⅛ saturated boric acid solution. Started January 3.

On January 6. 5 inoculated places had softened.

On January 7. 8 inoculated places had softened.

On January 9. 12 inoculated places had softened, of which 10 had fruited.

Exp. 7. Effect of saturated boric acid solution on citrus fruits. Started January 5.

To determine whether or not boric acid solution would affect citrus fruits in any way, experiments on a wide range of citrus fruits were made.

Five kinds of citrus fruits were used, namely,—tangerine, imported lemon, Florida lemon, Indian River orange, and California navel orange. In each test, 6 fruits of each kind were employed. Of these two were held as plain checks; two were punctured in two places each, and dipped in water for ten minutes; and two were similarly punctured and dipped in saturated boric acid solutions for ten minutes. The six fruits were then held in an open mailing box.

On January 6 in case of each variety absolutely no effect of the boric acid solution was found. There was no change in color, no withering or other effect. A few very small, loosely adherent crystals of boric acid could be made out on the surface of the fruit where drops of the boric acid had dried.

Exp. 8. Effects of inoculation with fungus spores on the inoculation places after dipping for ten minutes in saturated boric acid solution.

Spores were placed on the inoculation places 24 hours after dipping. Experiment started January 5. No changes are yet apparent.

Exp. 9. To test how far a water solution will penetrate in the pulp of the peel from the surface of the cut.

Only one orange was used for this experiment. A California navel orange was cut superficially in various places and then dipped for ten minutes in a water solution of eosin. The peel was then examined to see how far the red color had penetrated. The soft white pulp was found to have absorbed the color to a depth of from 1 to 2 millimeters,—less than 1/16th of an inch.

Exp. 10. 10 minute dip of inoculated oranges in ½ saturated boric acid solution. Started January 6.

No definite results so far, *i. e.*, mold has not yet had time to demonstrate its characteristic attack of the fruit on the control orange. So far, some growth of the fungus appears on the control, but none appears on the dipped orange.

Additional records later found in the files of the United States Department of Agriculture showing further work of that Department with boric acid and oranges and lemons, and United States Department of Agriculture correspondence with reference thereto.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C.

Office of the Chief.

December 31, 1904.

Mr. G. Harold Powell,
Riverside, California.

Dear Mr. Powell:

I enclose herewith a report on the methods employed and results obtained with apples and oranges in the use of the Baker process on a laboratory scale. The work was done in collaboration with Mr. Scott. The results with oranges indicate a distant effect due to the process in checking the development of penicillium. The experiment will be repeated by us. I also send an account of the first experiment with inoculated oranges and boric acid. This experiment is being repeated on the same scale as before, and will be repeated on a large scale next week, and results sent to you. We will be glad to receive and carry out any instructions or suggestions from you.

With best regards,

Yours very truly,

H. C. GORE.

Four enclosures.

BORIC ACID AND ORANGES.

FIRST EXPERIMENT.

Reported by H. C. Gore in collaboration with W. M. Scott.

Experiments with Boric Acid and oranges; started December 19, 1904. Four sound oranges (seeded Florida oranges) were inoculated in three places on each

fruit with a fine culture of penicillium glaucum. The abrasions into which the spores were inoculated were of three different kinds, all three kinds being used on each fruit. The kinds of abrasions made were as follows: a round hole about three m. m. in diameter, a stab, the blade of the scalpel being slightly twisted before withdrawal, and a cut made so as to remove a thin slice of the epidermis. In the photograph accompanying this report only the first kind of inoculation is shown. The four fruits were then numbered and treated as below, and then placed under a large glass bell jar on a ground glass plate, this arrangement serving as a moist chamber.

Fruit No. 1, not treated, used as control.

Fruit No. 2, powdered boric acid was gently rubbed into the abraded parts of the skin.

Fruit No. 3 dipped in a saturated solution of pure boric acid.

Fruit No. 4, abraded parts of skin bathed with a saturated solution of pure boric acid.

Results of above experiment

On December 24th (5 days later), it was noted that fruit No. 1 showed patches of green mold at each of the three points of inoculation. Nos. 2, 3 and 4 showed no change. By December 27th these patches on fruit No. 1 had grown larger, the other fruits being not affected. On Wednesday December 28th fruit No. 1 was well advanced in decay, while fruits Nos. 2, 3 and 4 were unaffected except No. 2, in which the area about the inoculated points was a little shrunken. Decay may be setting in here. At this time the four fruits were photographed. On December 30th No. 1 was nearly covered with green mold, but no further change was noticed in other specimens. On December 31st, however, Nos. 2, 3 and 4 showed unmistakable evidence of the development of the fungus. No. 2 showed soften-

ing at all three points of inoculation. Nos. 3 and 4 showed softening at two inoculation points on each fruit. In both of these the stab form of inoculation has not started to go down (this form of inoculation being most protected from extraneous spores.) For this reason, and also because the four fruits were kept together under the same bell jar during the time in which No. 1 was developing fungus spores in great abundance, it is believed that the decay noted in Nos. 2, 3 and 4 caused by a second inoculation of spores which came from fruit No. 1.

A. C. S.

Field Investigations

Indexed.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.
B. T. GALLOWAY, CHIEF.

Pomological Investigations.
G. B. Brackett, Pomologist.

Washington, D. C., Jan. 5. 1905.

Mr. G. Harold Powell,
Pomologist in Charge of
Fruit Storage Investigations,
Riverside, Cal.

Dear Mr. Powell:

To keep you informed of the status of the experiments on oranges, I send the final notes on our experiments so far as they have been completed, or are under way, with notes on a discussion of the problems which were brought out yesterday in a discussion of the boric acid work by Messrs. Taylor, Fulton, Scott and myself. Experiments to settle the problems discussed, which were problems which ought to be answered before the practical application of boric acid, will be undertaken to-day. I will send you an account of these experiments

when they are started, and later, when notes are taken. Meanwhile, we shall be very glad to try any experiments which may occur to you.

Yours very truly,

H. C. CORE.

Field Investigations.

EXPERIMENTS WITH THE BAKER PROCESS WITH ORANGES.

Notes Taken Jan. 3, 1905.

* * * * * * * * *

Series 1-A. Inoculated—not treated.

All fruits very badly decayed; nearly covered with blue mold; fruit discarded.

Series 1-B. Inoculated—treated one hour.

All fruits very badly decayed, but not quite so far gone as those in Series 1-A. Fruit discarded.

Series 1-C. Inoculated, treated and held under bell jar.

Fruit in good condition. One of the fifteen fruits had gone down, but the decay did not start from one of our inoculation points. A few inoculation points and surrounding areas showed the softening and translucence of the skin characteristic of the early stages of attacks of Penicillium. The difference between the fruits in this experiment and those in the two above experiments is very striking. The fruit was removed to open packages and will be reported on again later. Unfortunately, no control was run which would indicate whether or not this effect could be attributed to the closed package or to the process. A repetition of the experiment with proper control was started Tuesday, Jan. 3rd.

Series II-A, B, C and D. No marked difference as to ripeness of the oranges could be ascertained on Jan. 3rd. The experiments were discontinued.

First Experiment with Boric Acid and Oranges.

Final examination made Jan. 3, 1905. No. 1 (control) was entirely covered with blue mold spores. No. 2 showed development of mold on all three inoculation points. Nos. 3 and 4 showed development on two inoculation points on each orange, but in each case showed no mold on the stab form of inoculation.

Second Experiment with Boric Acid and Oranges.

Started Dec. 29, 1904. In order to test the results obtained in the first trial with boric acid, it was repeated, using, this time, a different variety of oranges —"California Navel." It also seemed to me (the experiment was started in the absence of Mr. Scott) that possibly the spores inoculated in fruits 3 and 4 had been washed out by the dipping and bathing, so this point was looked after. Six fruits were numbered, inoculated in three places in three different ways, as before, and treated as follows:

Fruit No. 1.

Not treated; control.

Fruit No. 2.

Powdered boric acid rubbed into inoculations.

Fruit No. 3.

Dipped for thirty seconds in a saturated solution of boric acid.

Fruit No. 4.

Inoculations bathed with saturated solution of boric acid.

Fruit No. 5.

Dipped for thirty seconds in distilled water.

Fruit No. 6.

Inoculations bathed with distilled water.

On Jan. 3, 1905, the results were as follows:

No. 1. All inoculated portions of fruit softened, showing the early stages of the decay.

Nos. 2, 3 and 4. Unaffected.

Nos. 5 and 6. All inoculated portions showed green patches of spores. On Jan. 4th, No. 1 began to show white mycelium threads and green spore formation. Nos. 2, 3 and 4 were unaffected, while the green patches on Nos. 5 and 6 were larger than the day before. At this time the fruits were photographed—photograph enclosed. The results are identical with those of the first experiment. It is of interest that Nos. 5 and 6 developed the fungus faster than No. 1.

Work Started Jan. 3, 1905.

At this date Mr. Scott and I started six experiments, using "California Navel" oranges. The experiments were as follows:

1. Baker process, using twenty inoculated oranges. Fruit was held under bell jar.

2. Boric acid. Twenty inoculated oranges were dipped for ½ minute in a saturated solution of boric acid. Fruit held under bell jar.

3. Control—consisting of twenty inoculated oranges held under bell jar. In addition, in bell jars of experiments 1 and 3 an inoculated potato culture was placed.

4. Three inoculated oranges were placed in a moist chamber, after dipping for thirty seconds in a ⅓ saturated solution of boric acid.

5 and 6. Four inoculated oranges were placed in a moist chamber after dipping for thirty seconds in a ¼

or 1/8 saturated solution of boric acid, respectively. Results on the above six experiments are expected to show after five days.

The work planned for to-day was suggested at the discussion yesterday, at which Mr. Taylor described the process of washing and brushing employed at a lemon packing house which he visited last winter. In this process, he said that fruits remained in the water at least ten minutes. It would be necessary then to determine the following points:

1. Will ten minutes dipping in boric acid solution injure the fruit in any way.

2. Will crystals form on the fruit in noticeable quantity, or could crystals readily get on the fruit by careless application of boric acid? The possibility of crystal formation in the fruit suggested that a further dipping in water or in dilute boric acid solution may be sufficient to remove excess of boric acid.

Consideration of the further handling of the lemon or orange after washing and brushing led to the following question:

3. Can *re-inoculation* take place through abrasions of the skin of the orange which has been soaked in the boric acid and then somewhat dried? Such infection could, of course, very readily occur in the car, especially if the car was badly infected with the fungus. As noted above, these problems will be made the basis of experiments to be started to-day. An account of the experiments will be sent to you at once.

A. C. S. Indexed. Field Investigations.

Jan. 5, 1905.

Mr. G. Harold Powell,
Pomologist in Charge of
Fruit Storage Investigations,
Riverside, Cal.

My dear Powell:

Mr. Gore, having reached a point in his boric acid treatment experiments where certain phases of the method of washing and subsequent handling of the fruit in the California packing houses needed to be considered, he, Scott, Fulton and myself, had a conference yesterday afternoon on the subject. The fruits that were dipped after being inoculated show very striking results in the line of preventing rot development. There are a few crystals of boric acid visible on the fruits, and this makes it almost certain that with packing house methods there would be a good deal of boric acid visible if a saturated solution is necessary to secure the desired effect. The one-half, one-fourth and one-eighth strength solutions now under test will probably throw some light on this point by the first of next week. It would, of course, be unfortunate to suggest any processes that would be likely to cause a scare among consumers, even though it should be baseless, for it is difficult to correct misapprehensions of that sort if they once gain headway through the press.

Gore suggests that if a saturated solution is found to be necessary, that a subsequent rinsing dip in a dilute solution might obviate the difficulty without materially endangering the effectiveness of the process. Mr. Gore will send his detailed notes to-day or to-morrow, and meanwhile we will endeavor to keep the tests going. Should any points in his notes or in these comments on the work appear to you to require quick mod-

ification, I think it would be well to telegraph so as to save time. Mr. Fulton will keep in close touch with these phases of the work, so that when the shipment stage is reached later in the season there will be a complete understanding of the matter at both ends of the line.

I enclose Botanical Society notice for meeting this week.

With kindest personal regards to yourself, Stewart and the family, I remain,

Yours very truly,

WM. A. TAYLOR,
Pomologist in Charge of Field Investigations.

ALB
Division of Foods.

Field Investigations.
Indexed

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C.

January 10, 1905.

Mr. G. Harold Powell,
Pomologist in charge of Fruit Storage Investigations,
Riverside, Cal.

Dear Mr. Powell:—

In the account of the work being carried on by us, which was mailed to you on January 6th, were described the results obtained by applying the Baker process to oranges kept in an air tight bell jar. These results appeared to be extremely favorable to the process when they were compared with two other experiments in which inoculated fruit was held in open packages.

It was noticed, however, that unfortunately no proper control was run with the experiment, which

would eliminate the effect of the closed package. On January 3rd, experiment Series I C was repeated, using a proper control,—this work constituting experiments 1 and 3. The results of this work, as far as completed, indicate that the earlier favorable result, supposed to be due to the Baker process, is probably due to the closed package.

With this letter, a report of the final results on experiment Series I C will be enclosed, as well as an account of other experiments completed or under way.

In a further series of experiments which we have just started, inoculated oranges were treated to a ten minute dip of boric acid solution, then drained, wrapped and stored in the laboratory in mailing boxes. Varying strengths of boric acid solution were employed in the several experiments.

These experiments will give the first results in about five days. The fruit will, however, be held in the boxes as long as possible.

Yours very truly,

Enclosure.

H. C. GORE.

FINAL RESULTS WITH EXPERIMENTS SERIES I C.

First treated by the Baker process, and kept under bell-jar until January 3.

Eleven fruits were removed to mailing boxes on January 3rd. After six days, 17 of the 22 inoculations had softened down. No permanent check of the growth of the fungus is therefore shown.

Exp. 1. Baker process. Duplicate of Exp. 1 Ser. 1. I C. Started January 3, 1905.

On January 5. No changes.

On January 9. A very slight development of the fungus was noted at five of the inoculated places, the exposed white surface of the rind showed development of white mycelia and green spores of mold, but the

orange was not attacked in the usual manner by the mold.

Exp. 3. Control of Exp. 1,—also control of Exp. 2. Started January 3.

On January 9. A very slight development of the fungus was noted at 14 of the inoculation places, the exposed white surface of the rind showed development of white mycelia and green spores of the mold, but the orange was not attacked in the usual way by the fungus.

Exp. 2. ½ minute dip in saturated boric acid solution. Kept in air tight bell jar. Started January 3.

On January 7. No change.

On January 9. No change.

Exp. 4. ½ minute dip in ½ saturated boric acid solution. Kept in moist chamber. Started January 3.

On January 6. 1 inoculated place had softened.

On January 7. 3 inoculated places had softened.

On January 9. 7 inoculated places had softened, of which 6 had fruited.

Exp. 5. ½ minute dip in ¼ saturated boric acid solution. Kept in moist chamber. Started January 3.

On January 6. No inoculated places had softened.

On January 7. 4 inoculated places had softened.

On January 9. 11 inoculated places had softened of which 8 had fruited.

Exp. 6. ½ minute dip in ⅛ saturated boric acid solution. Started January 3.

On January 6. 5 inoculated places had softened.

On January 7. 8 inoculated places had softened.

On January 9. 12 inoculated places had softened, of which 10 had fruited.

Exp. 7. Effect of saturated boric acid solution on citrus fruits. Started January 5.

To determine whether or not boric acid solution would affect citrus fruits in any way, experiments on a wide range of citrus fruits were made.

Five kinds of citrus fruits were used, namely,—

tangerine, imported lemon, Florida lemon, Indian River orange, and California navel orange. In each test, 6 fruits of each kind were employed. Of these two were held as plain checks; two were punctured in two places each, and dipped in water for ten minutes; and two were similarly punctured and dipped in saturated boric acid solutions for ten minutes. The six fruits were then held in an open mailing box.

On January 6 in case of each variety absolutely no effect of the boric acid solution was found. There was no change in color, no withering or other effect. A few very small, loosely adherent crystals of boric acid could be made out on the surface of the fruit where drops of the boric acid had dried.

Exp. 8. Effects of inoculation with fungus spores on the inoculation places after dipping for ten minutes in saturated boric acid solution.

Spores were placed on the inoculation places 24 hours after dipping. Experiment started January 5. No changes are yet apparent.

Exp. 9. To test how far a water solution will penetrate in the pulp of the peel from the surface of the cut.

Only one orange was used for this experiment. A California navel orange was cut superficially in various places and then dipped for ten minutes in a water solution of eosin. The peel was then examined to see how far the red color had penetrated. The soft white pulp was found to have absorbed the color to a depth of from 1 to 2 millimeters,—less than 1/16th of an inch.

Exp. 10. 10 minutes dip of inoculated oranges in ½ saturated boric acid solution. Started January 6.

No definite results so far, *i. e.*, mold has not yet had time to demonstrate its characteristic attack of the fruit on the control orange. So far, some growth of the fungus appears on the control, but none appears on the dipped orange.

COPY.

U. S. DEPARTMENT OF AGRICULTURE
Bureau of Plant Industry,
B. T. GALLOWAY, *Chief.*

Fruit Storage Investigations,
G. HAROLD POWELL, *Pomologist in Charge.*

Pomological Investigations
G. B. BRACKETT, *Pomologist.*

Washington, D. C.

My dear Taylor:

I have yours of the 5th regarding the boric acid dip. I do not think of anything just now to add to the outline which I received tonight from Gore. The results, some of which I looked over before leaving, are very suggestive. People shy at the word borax now a days and I have not thought of suggesting it until the boys work a good deal more on it. Then we may try it on the quiet on a commercial scale. The dip would have to be distinct from the washing. On account of the dirt from the fruit, the water in the wash is running all of the time. But the fruit might be dipped after that. With the oranges, of which not 5% is washed, I doubt the advisability of any liquid disinfectant, as the packing houses are taxed to their limit and the wetting of the fruit means the enlarging of the house capacity and much added labor. I shall be interested in the effect of the weaker solutions as they might be used on lemons if they are efficient and the chrystals do not show. I will suggest to Gore that the work be duplicated on lemons (if my hand is not paralyzed before that time)

Stewart and I spent the day with Mills riding over the Trust Co. orchards. We are now ready to go to work and begin some orchard handling experiments

tomorrow. They are willing to cooperate there to any extent. I think we can use a couple of cars of fruit if needed. It takes some time to get the foremen into line (and without them you can do nothing) but we have them all right now. I find one of Father's boys at Briarcliff in the Packing House in a position where he will be of great help. The cooling work has interested these people more than any other phase and I hope we can accomplish a lot of good along this line. I am sure it will apply when the bad weather comes as much as it did to the peach. Little is anxious that it be tried on lemons in June.

I can see the effect of our visit last year in a number of packing houses in the improved appliance and greater care used. Our trip served to focus attention on some of these questions and some of the houses have put in new equipment from the bottom up. This slow education influence will be the most we can hope for, and this is the most valuable kind of progress as the whole industry is gradually bettered by it. What is needed now is a number of funerals more than anything else, the old packing house manages to form the principal actors. Maybe the borax will do the trick.

We like our quarters very much. The most strenuous part of life here is the boarding-house question. Stewart has visited at least thirty restaurants and is getting a little gaunt from the exercise. We fare a little better as we occasionally roast a potato on the end of a stick, or make some patent coffee over the lamp. Our neighbors also bring in oranges, lemons, grapefruit and tangerines (for the boys they say). We have at least a hundred specimens in the windows, on the bureaus and under the bed at the present time. I am very sorry we can't divide with all of you.

There has been a fine rain—more than 2 inches here, and nearly 4 inches around Redlands. The green

is beginning to show on the hills. The groves look fine too. There are hundreds of acres of Canada Peas in the groves this year. Last year there were only a few. The Trust Co. has more than 2000 acres.

I have accepted an invitation to talk at an apple growers meeting at Los Angeles next week Saturday. It will be a good opportunity to get in touch with this interest.

Give my regards to all in the office. With personal regards,

Yours very truly,

G. HAROLD POWELL,

To W. A. Taylor
Pomologist & C.

Riverside, Cal.
Jan. 11, 05.

copy from Carbon written in longhand.

My dear Mr. Gore:

I have been trying to find time to reply to the two interesting communications from you regarding the Baker Process and the Boric acid treatment to check the development of mold. I shall be much interested in further reports on both lines. The Baker Process effect on the mold on oranges is very suggestive. If in the present test it continues to hold back the mold, I would suggest that it be tried again on apples and that it be extended to lemons. It will be especially interesting to see what happens to the mold when the fruits are removed from the bell jars.

The boric acid results are striking and I shall look forward with interest to reports on the present tests. I would suggest that these tests be extended to the lemon as it would find its greatest usefulness with this fruit if it should develop as a promising commercial proposition. Not 5% of the oranges are washed and I do not

think it would be practical to adopt washing on account of the added labor and expense. Oranges are dry brushed and packed at once. Lemons are washed, then cured for a few days in sweat boxes or for months more slowly in tents. Washing adds to the labor and especially to the capacity of the packing house on account of the need of room for drying after the fruit leaves the water.

(*The first line of this paragraph seems to be cut off at the top of the sec. page.*) lemon if its value made it worth while. The dipping acid would need to be separate from the present washing as the dirt on the fruit necessitates a running stream of water through the washing machine in order to keep it clean. A bath could be provided after the washing and before the fruit is set aside to cure.

Commercially I am afraid of the effect of such a treatment unless it is handled with great care. The trade shies at its own shadow and a borax panic could easily be worked up by the dealers in foreign lemons who are fierce competitors with the Californians.

I think you are covering the points but I would suggest that you determine the minimum strength of acid that is efficient at, say, one half, one, three or five minutes dip, and for immediate immersion and removal; and the effect of these different treatments on the fruit, also whether it is possible to reduce the strength so that there will be no chrystallization on the fruit.

We are getting into our work now and are pretty busy. With kind regards.

Yours very truly,

G. HAROLD POWELL.

to Mr. H. G. Gore,
Bureau Chemistry,
Riverside, Cal.
Jan. 13, 1905.
ECH.

Further Results on Experiments Under Bell Jars—Experiments 1, 2 and 3.

Exp. No. 1, Baker Process.

Exp. No. 2, Boric Acid Dip, using Saturated Boric Acid for 30 seconds.

Exp. No. 3, Control of Nos. 1 and 2.

All fruit in the above experiments were inoculated in two places each. Sixty fruits in all were employed—twenty being used in each bell jar.

On Jan. 13th the appearance of the fruit was the same as on Jan. 9th—that is, practically unchanged—no growth of fungus or other visible change had taken place. At this time the gas in each jar was analyzed, the jars opened, and the fruit kept in open packages, where it is now under observation.

The analysis of the gases are as follows:

	Carbonic Acid gas	Oxygen	Nitrogen by Difference
In Jar No. 1,	66.0 0/0	0.00 0/0	34. 0/0
" " " 2,	75.9 "	0.00 "	24.1 "
" " " 3,	74.0 "	0.00 "	26.0 "

Mr. Scott and I tasted the fruit from each jar immediately after opening. To us all samples seemed to be decidedly off in flavor.

On the following morning Mr. Taylor tasted a fruit from each jar and also a fruit from a plain check, and found that the differences in taste were not greater than would ordinarily obtain in different fruits from the same box of oranges, with the exception of fruit from No. 1 (Baker Process.)

This fruit had a decidedly off flavor which could be described as a smoky taste, a cold storage taste, or as if the fruit were affected by a growth of mold—the off-taste being distinct—but difficult to describe.

On Jan. 14, all fruits remaining in Exp. 1, had browned and shrunken rinds. In Exp. 2 and 3, much

less of this browning and shrinking was present—there was more on fruits in No. 2 (boric acid) than those in No. 3 (control).

The results of the above three experiments so far as obtained show that the Baker process (as we applied it) injures the fruit, and that the only favorable effect is due to the closed package. The cause of the effect of the closed package is indicated by the results of the gas analyses, no growth of aerobic fungus forms presumably being possible in the absence of oxygen. Further experiments would doubtless be of interest to determine how rapidly oranges are able to consume the oxygen in the gas with which they are wrapped, and an interesting chemical problem would be to determine at the expense of what constituents of the orange so much carbon dioxide is formed.

Exp. 8, Effect of After Inoculation.

Six California Navel oranges were stabbed with a knife blade, but not inoculated. Four of them were then dipped in saturated boric acid solution for ten minutes. After standing in an open mailing box for about 24 hrs. each stab in the four oranges was dusted with spores of penicillium glaucum. Two oranges (Nos. 5 and 6) were maintained as controls. These fruits were treated exactly as the other four except that they were not dipped. Three fruits were then held in a loosely covered mailing box and three were left in a moist chamber.

Nos. 1, 2 and 5 were held in the mailing box. Nos. 3, 4 and 6, being kept in a moist chamber.

The experiment was started Jan. 5, on Jan. 9, No. 6 showed development of fungus.

On Jan. 12, No. 5, began to show decay; the decay of No. 6, was well advanced, while the other four fruits showed no development of the fungus.

On Jan. 13, no changes were noted in case of fruits 1, 2, 3, and 4.

On Jan. 17, Nos. 1 and 2 showed no development of the fungus.

In case of fruits 3 and 4, one inoculation fruit out of the six, on fruit No. 3, showed the softening. No. 4 being unaffected. At this time the experiment was discontinued.

The experiment indicates that by the ten minute dip in saturated boric acid solution, the abraded portion of the fruits will be protected from decay caused by spores falling upon them after the boric acid treatment.

Exp. 10, Boric Acid ½ Saturated.

Started Jan. 6, 1905.

Four California Navel oranges were employed. Each fruit was inoculated in six places penicillium glaucum. One orange was soaked in water, and the remainder were soaked in ½ saturated boric solution. The four fruits were held in a moist chamber.

The experiment was started Jan. 6, 1905.

On Jan. 9, the control showed a slight growth of blue mold in each inoculated place. No such effect was visible in case of the oranges dipped in ½ saturated boric acid.

On Jan. 12, 05, the control showed development of fungus at five of the inoculated places out of the six on the fruit. No change on the other fruits.

Jan. 17, 1905—Control was nearly covered with green mold. Of the 18 inoculations on the other three fruits, 12 showed inoculated growth of the fungus. Experiment discontinued.

The results of this experiment shows that though not absolutely inhibitive, a marked retardation of the

growth of the mold is caused by half saturated boric acid solution.

Experiments 11-16 inclusive.

These experiments were conducted to find out the effect of boric acid solution of varying strength, on the development of penicillium on inoculated oranges. California Navel oranges were used. Each fruit was inoculated in six places using a stab puncture which penetrated through the rind but not into the pulp. A dip of ten minutes was used. Twelve fruits were used in each experiment except in No. 15 and 16, which were controls in which six fruits were employed.

In each experiment, after dipping, the fruits were drained for ten minutes, and then wrapped, and held in closed mailing boxes.

The experiments were started on Jan. 9, and examined Jan 17.

The experiments and results were as follows:

Exp. No.	Strength of Boric acid	0/0 of Inoculation, at which the fungus developed	0/0 of Inoculation, at which green spores were formed
11	Saturated	4	2
12	½ "	47	17
13	¼ "	92	58
14	⅛ "	99	83
15	.....	100	83
16	.....	100	75

In Exp. No. 15, the fruit was dipped in water. In Exp. No. 16, the fruit was not dipped.

This series of experiments shows, first, that the full strength of boric acid, or a strength between that of a saturated and of a ½ saturated solution is necessary to

check the growth, second, it will be noted that there is a marked retardation of the fungus due to the boric acid above 1/8th strength. There were no crystals of boric acid to found on any of the fruits, the wrapper seeming to absorb any drops of the acid solution which were still clinging to the fruits.

H. C. G. Field Investigations
M. C. G. Indexed

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C.

Division of Foods.

Washington, D. C., January 20, 1905.

Mr. G. Harold Powell,
Pomologist in Charge of Fruit Storage Investigations,
Riverside, California.

Dear Mr. Powell:—

Your letter of January 13th is at hand. The information you give will help us very materially in planning experiments which will be designed to show whether the boric acid treatment will be practicable commercially. The work already planned, which Mr. Scott and I will carry out today, is to try the effect of saturated, three quarters, and half-saturated boric acid solutions on inoculated oranges in which the cuts in the skin are of different kinds, the time of dip being still ten minutes, and oranges used (instead of lemons) because the results will be more comparable with those already secured. We have used very largely two types of puncture, which it was hard to be sure were always reached by the boric acid, on account of the possibility of protection by bubbles of air. The aim now, is to imitate as well as possible the types of abrasion which would occur in commercial handling.

We haven't yet planned the experiments with lemons. We will keep in mind the information and suggestions you have given, and will be very glad of further ones from you. An account of the progress of the work up to date is inclosed.

Yours very truly,

H. C. GORE.

Inclosure:

Report of Work on Oranges.

ECH.

Further Results on Experiments Under Bell Jars—Experiments 1, 2 and 3.

Exp. No. 1, Baker Process.

Exp. No. 2, Boric Acid Dip, Using Saturated Boric Acid for 30 seconds.

Exp. No. 3, Control of Nos. 1 and 2.

All fruit in the above experiments were inoculated in two places each. Sixty fruits in all were employed—twenty being used in each bell jar.

On Jan. 13th the appearance of the fruit was the same as on Jan. 9th—that is, practically unchanged—no growth of fungus or other visible change had taken place. At this time the gas in each jar was analyzed, the jars opened, and the fruit kept in open packages, where it is now under observation.

The analyses of the gases are as follows:

	Carbonic Acid gas	Oxygen	Nitrogen by Difference
In Jar No. 1,	66.0 0/0	0.00 0/0	34. 0/0
" " " 2,	75.9 "	0.00 "	24.1 "
" " " 3,	74.0 "	0.00 "	26.0 "

Mr. Scott and I tasted the fruit from each jar immediately after opening. To us all samples seemed to be decidedly off in flavor.

On the following morning Mr. Taylor tasted a fruit from each jar and also a fruit from a plain check, and found that the differences in taste were not greater than would ordinarily obtain in different fruits from the same box of oranges, with the exception of fruit from No. 1. (Baker Process.)

This fruit had a decidedly off flavor which could be described as a smoky taste, a cold storage taste, or as if the fruit were affected by a growth of mold—the off-taste being distinct—but difficult to describe.

On Jan. 14, all fruits remaining in Exp. 1, had browned and shrunken rinds. In Exp. 2, and 3, much less of this browning and shrinking was present—there was more on fruits in No. 2 (boric acid) than those in No. 3. (control).

The results of the above three experiments so far as obtained show that the Baker process (as we applied it) injures the fruit, and that the only favorable effect is due to the closed package. The cause of the effect of the closed package is indicated by the results of the gas analyses, no growth of aerobic fungus forms presumably being possible in the absence of oxygen. Further experiments would doubtless be of interest to determine how rapidly oranges are able to consume the oxygen in the gas with which they are wrapped, and an interesting chemical problem would be to determine at the expense of what constituents of the orange so much carbon dioxide is formed.

Exp. 8. Effect of After Inoculation.

Six California Navel oranges were stabbed with a knife blade, but not inoculated. Four of them were then dipped in saturated boric acid solution for ten minutes. After standing in an open mailing box for about 24 hrs. each stab in the four oranges was dusted with spores of penicillium glaucum. Two oranges (Nos. 5

and 6) were maintained as controls. These fruits were treated exactly as the other four except that they were not dipped. Three fruits were then held in a loosely covered mailing box and three were left in a moist chamber.

Nos. 1, 2 and 5 were held in the mailing box. Nos. 3, 4 and 6 being kept in a moist chamber.

The experiment was started Jan. 5, on Jan 9, No. 6 showed development of fungus.

One Jan. 12, No. 5, began to show decay; the decay of No. 6, was well advanced, while the other four fruits showed no development of the fungus.

On Jan. 13, no changes were noted in case of fruits 1, 2, 3 and 4.

On Jan. 17, Nos. 1 and 2 showed no development of the fungus.

In case of fruits 3 and 4, one inoculation fruit out of the six, on fruit No. 3, showed the softening. No. 4 being unaffected. At this time the experiment was discontinued.

The experiment indicates that by the ten minute dip in saturated boric acid solution, the abraded portion of the fruits will be protected from decay caused by spores falling upon them after the boric acid treatment.

Exp. 10. Boric Acid ½ Saturated.
Started Jan. 6, 1905.

Four California Navel oranges were employed. Each fruit was inoculated in six places penicillium glaucum. One orange was soaked in water, and the remainder were soaked in ½ saturated boric solution. The four fruits were held in a moist chamber.

The experiment was started Jan. 6, 1905.

On Jan. 9, the control showed a slight growth of blue mold in each inoculated place. No such effect was

visible in case of the oranges dipped in ½ saturated boric acid.

On Jan. 12, 05, the control showed development of fungus at five of the inoculated places out of the six on the fruit. No change on the other fruits.

Jan. 17, 1905—Control was nearly covered with green mold. Of the 18 inoculations on the other three fruits, 12 showed inoculated growth of the fungus. Experiment discontinued.

The results of this experiment shows that though not absolutely inhibitive, a marked retardation of the growth of the mold is caused by half saturated boric acid solution.

Experiments 11-16 inclusive.

These experiments were conducted to find out the effect of boric acid solution of varying strength, on the development of penicillium on inoculated oranges. California Navel oranges were used. Each fruit was inoculated in six places using a stab puncture which penetrated through the rind but not into the pulp. A dip of ten minutes was used. Twelve fruits were used in each experiment except in No. 15 and 16, which were controls in which six fruits were employed.

In each experiment, after dipping, the fruits were drained for ten minutes, and then wrapped, and held in closed mailing boxes.

The experiments were started on Jan. 9, and examined Jan. 17.

The experiments and results were as follows:

Exp. No.	Strength of Boric acid	0/0 of Inoculation, at which the fungus developed	0/0 of Inoculation, at which green spores were formed
11	Saturated	4	2
12	½ "	47	17
13	¼ "	92	58
14	⅛ "	99	83
15	.....	100	83
16	.....	100	75

In Exp. No. 15, the fruit was dipped in water. In Exp. No. 16, the fruit was not dipped.

This series of experiments shows, first, that the full strength of boric acid, or a strength between that of a saturated and of a ½ saturated solution is necessary to check the growth, second, it will be noted that there is a marked retardation of the fungus due to the boric acid above ⅛th strength. There were no crystals of boric acid to found on any of the fruits, the wrapper seeming to absorb any drops of the acid solution which were still clinging to the fruits.

A. C. S. Field Inspections

Jan. 20, 1905.

Mr. G. Harold Powell,
Pomologist in Charge of
Fruit Storage Investigation,
Riverside, Cal.

My dear Powell:

Yours of the 9th, 11th and 13th instant came duly, also telegram of 14th regarding the thermographs. I found that we could get no discount on the Friez instrument, the only thermograph available at short no-

tice, so ordered three, which are now here. The carpenters are making the cases and shipping boxes so that we can forward them to you to-morrow ready for use. I wired you yesterday as follows:

"Will express three thermographs Saturday. Can you send two boxes unwashed lemons in some Eastern car, for express here from destination?"

There are no California lemons in this Market, and we feel that unwashed stock, fresh from the tree, would be very much better for the experimental work than Mediterranean fruit.

I have just been conferring with Drs. Galloway and Woods in regard to the best way to handle the authorization amendment to cover the time after expiration of the thirty day limit. This matter is up for consideration. We are endeavoring to shape a General Order which will interpret No. 80 so that the latter can be applied uniformly throughout the Department. Meanwhile, we are asking for an amendment of your and Stewart's authorization, extending the thirty days to ninety days at southern California points.

I enclose two or three letters that appear to need your personal attention. Davidson did not send the circular which he refers to, and I have called his attention to the omission, giving him your Riverside address.

I also enclose copy of a letter from Dr. Galloway, dated the 18th, in relation to the use of letter heads with names thereon. We are reforming in this respect and will mail you tomorrow stationery which will be safe for you to use.

The weaker solutions of boric acid do not appear to be nearly as effective as the saturated solution. Mr. Gore will send you notes on the last observations. There appears to be sufficient retarding effect in the half strength solution to make a three-quarter strength test

desirable, so that will be taken up immediately. Less than half strength will hardly be effective, even with a ten minute dip.

Trusting that this finds you all in good health and spirits, I remain, with personal regards,

Yours very truly,

W. H. TAYLOR,

Pomologist in Charge of Field Investigation.

Field Investigations
Indexed.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

ehb

Vegetable Pathological and Physiological Investigations.

Washington, D. C., Feb. 6, 1905.

Mr. G. Harold Powell,
412 Tenth Street,
Riverside, Cal.

Dear Mr. Powell:

I believe Mr. Gore has been keeping you informed as to the progress of our work on oranges, and I will therefore not give you any details of the tests we have been making. The results of the boric acid test are quite promising, and we were just about to ask you to make a commercial test when it developed that Mr. Tenny of this Office had been temporarily detailed to work with you on just such problems. Mr. Gore and I have had a talk with Mr. Tenny, and he says he will be glad to make whatever field tests we may desire and, if agreeable to you, he will duplicate under commercial conditions some of the tests that have been made here in the laboratory. A 3 per cent strength of boric acid used as a dip seems to prevent the development of the

Penicillium rot in oranges and lemons almost perfectly. I am aware, however, that when brought to actual test in the field and under commercial conditions the treatment may prove worthless, but the results obtained here in the laboratory are certainly sufficient to warrant more extensive tests. If you can arrange for Mr. Tenny to inoculate and dip some fruit and ship it, together with the proper controls, in a car to Washington or some nearby point, Mr. Gore and I will take care of this end of the work. Mr. Tenny says that he will likely be able to run these tests in a car which you have secured for making various experiments in connection with your work. Whatever additional tests you and Mr. Tenny can carry on on your own account will give additional data from which to draw final conclusions.

With best wishes, I am

Yours very truly,

W. M. SCOTT.

356 Filed.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.
Office of Pomologist.

Riverside, Cal., Feb. 15, 1905.

Mr. W. M. Scott,
U. S. Department of Agriculture,
Washington, D. C.

My Dear Scott:—

I have your esteemed favor of the 6th inst regarding the tests with boric acid to prevent development of rot in oranges and lemons in transit. We shall be very glad to make some commercial tests with this material and forward the fruit in a car going to Washington or to some nearby point. I think that we will make some tests on a considerable scale in a short time here, hold-

ing the fruit under our observation rather than forwarding it. For the shipments I think it will be well to leave the matter until March when the fruit is riper and the weather warmer.

We have been very much interested in these tests and they are suggestive of the value of the boric acid treatment for the purpose designed. I am somewhat skeptical, however, in regard to the use of boric acid for this purpose, as I am afraid the trade would be very scary if it should get hold of the fact that any California fruits were dipped in this material. It would especially stir up our German friends.

I wish we might trade some of our orange and poppy weather for your 10 ft. snow drifts. We would not care for it for any length of time, but it would be a novelty to see a good white snow-drift.

With personal regards, I am,

Yours very truly,

G. HAROLD POWELL,

Pomologist in charge fruit storage investigations.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

Office of Pomologist

Riverside, California, February 27, 1905

Dear Sir:—

I desire to call your attention to the amount of fruit that is injured by the shears in cutting the oranges from the tree. After looking over a large amount of fruit as it is received in the packing houses in different parts of Southern California, it is safe to say that an average of one in every five or six oranges has had the skin either badly cut or slightly punctured by the clippers. The cuts may be a quarter of an inch across, or so small as to be detected only by the most critical ex-

amination. There is a wide variation in the amount of injury in the fruit coming from different growers, and a difference still greater in the fruit picked by different men. In order to bring these facts out clearly we give the percentage cut by the clippers in oranges examined from twenty-two representative groves in different parts of the state—

29.	22.5	11.9	28.3
18.8	16.4	13.1	24.4
28.8	28.0	11.0	8.3
8.0	35.0	12.0	16.7
10.6	19.0	21.0	15.0
	4.2	15.8	

To show the variations in the amount of fruit injured by different pickers, the following representative figures are taken from a record of fifteen boxes in a single load of fruit—

33.0	22.5	18.2	32.5
18.3	44.0	22.7	47.7
20.2	67.0	25.0	41.4
15.5	20.8	22.0	

per cent. This grower's fruit averaged 29 per cent cut.

Another common form of mechanical injury results from cutting the stems long. We here give figures showing the percentage with stems cut long enough to do injury based upon fruit of ten leading growers:

5.0	6.0	14.0	31.0
6.1	6.9	34.0	30.6
	17.0	11.0	

An equally wide variation is found in the fruit of different pickers.

A large proportion of the cutting is done by the most flagrant carelessness on the part of the picker, who is often encouraged to pick more fruit than he can handle carefully.

On the other hand a good deal of this injury results from the use of pointed shears, the picker inserting the sharp points into the skin in the effort to cut the stem short. This type of injury is difficult to see, but we have found as much as 15 to 20 per cent in groves in which a determined effort is made to make the pickers careful. In the groves showing 4.2 per cent of cut fruit —a grove famous for the carrying quality and high price of the fruit—the use of a round, blunt shears is responsible in no small measure for the result.

Probably not 5 per cent of this clipper cut fruit is detected as it passes through the hands of the grader or the packer. The prominent gashes only are seen. The remainder of the injured oranges, of course, do not all decay, but the injury makes them particularly susceptible to rot from blue mould, if the conditions become favorable at any time for its development. In our experiments, as much as 40 per cent of the cut fruit has developed decay under ordinary conditions, while uninjured fruit under similar conditions has shown less than 1 per cent. The essential conditions for this decay are that the spores of the disease be present, that there be sufficient moisture, and a temperature high enough to germinate them and to make them grow, and a weakness in the skin of the orange through which the disease can enter. If any one of these factors is wanting there is slight chance for the orange to decay from this disease.

A fundamental requirement either for successful shipping, or for storing, is sound fruit. Mechanical injuries of this nature render the oranges liable to decay in warm weather, and account for no small part of the trouble that arises when the fruit is on the way across the continent. There are other factors that favor decay, but a bruised orange that becomes infected with disease may rot in spite of the best conditions that transportation now provides.

This statement is in keeping with the results of the Department of Agriculture in its Fruit Storage Investigations where it has been found that a very large proportion of the losses in cold storage is the direct result of the bad handling of the fruit before it enters the warehouse.

In order to bring the matter out for discussion we suggest several ways by which clipper bruising and long stems may be reduced:

1st. By using shears with blunt ends or protected ends, or by rounding the ends of pointed shears already in use.

2nd. By making the conditions favorable so that the quality of the picking rather than the quantity may be the prime consideration with the picker.

3rd. By adopting a system of ticketing the boxes of individual pickers in order that the persistently careless picker may be eliminated. We have found as much as 65 per cent of cut fruit in some boxes and one per cent in others in the same grove.

4th. The individual grower, the packing house, or a combination of packing houses could employ bright young men to inspect the fruit in the groves, or the fruit of different growers coming to the packing houses, in order to locate and follow up the careless and the shiftless picker, as well as the grower, and to suggest practical means of overcoming the trouble.

In conclusion, we would suggest that every orange grower take twenty-five boxes of his own fruit, and that every packing house manager take as many boxes of fruit from different patrons of the house, and determine by critical inspection of every orange the amount of fruit cut and having long stems.

These troubles cannot be judged by a casual esti-

mate nor by the critical inspection of a single box of fruit. Observations of this kind would lead the grower to think that he did not belong to the class brought out in some of the figures given above. It takes a quantity of fruit and sharp eyes to make an accurate determination.

Very truly yours,
G. HAROLD POWELL,

Pomologist in Charge Fruit Storage Investigations.

Pomological Investigation. Received. January 19, 1905. Answered 1/20, '05.

Field Investigations

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.
B. T. GALLOWAY, CHIEF.

Fruit Storage Investigations,

G. Harold Powell, Pomologist In Charge.

Pomological Investigations.
G. B. Brackett, Pomologist.

Washington, D. C.,

My Dear Taylor:

I wired this morning for Thermographe and have your reply that a Draper has been expressed. I will wire in the morning that we need three now and will need a total of five new ones by March 15. If we can afford it, the Friez Thermographs had better be purchased as they give better results in transit.

We need them now for some lemon forcing work at different temperatures. Lemon demand has been so good that the entire crop is shipped out as fast as it is picked and forced. As we get closer other packing

house men we are getting at their real troubles. (I learned today, that the Trust Co. probably threw out 150 cars of lemons last year). Just now there is a good deal of trouble with a peculiar discoloration of the fruit after sweating. It looks like over heating and we will begin rooms in a few days at 70°, 80° and 90°. I don't believe Little can depend on his packing house men to give him the real temperature, so we need thermometers.

We will need a dozen in March, so if we can get five new ones now, we will have to withdraw the rest from the farm storages.

We began the grove handling work this morning at the Trust Co. and continue it tomorrow. Their Prenda house is much like Hales in being removed from everybody. The foremen, as well as the officers, like Frazer Mills and Little are in line, so we can accomplish a good deal there. The only thing I am not quite clear about is the effect of doing work of this kind with English capital. The work must help the packing house a good deal. Facility for work must be the principal consideration in experimental work, and I will have a talk with Mr. Chase about it tomorrow.

Stewart and I are picking all the fruit we need ourselves so that we may know first hand about the practical difficulties in handling the fruit carefully in the grove. I think we could pick about 2¾ boxes each a day if we hurried. We find that a clipper has a good many more sharp points that you can see with the eye. That the oranges drop into the bag in spite of resolutions, and that some of the theories we worked out with mathematical precision while it was raining go up in mist when you have a sack over your shoulder in a boiling sun. I am an evolutionist and I have faith that

these difficulties will disappear as we add experience to our theories.

With kind regards to all

Yours very truly

G. HAROLD POWELL.

To Mr. W. O. Taylor
Pomologist In Charge
Riverside, Cal.
Jan. 13, 1905.

356 Filed.

Riverside, California.

Report of Field Work, G. Harold Powell, Pomologist in Charge of Fruit Storage Investigations, for week ending March 6, 1905.

February 27. At Prenda Packing House examining fruit experimental series.

February 28. At Upland determining amount of clipper cut fruit in lots of various growers. In this house a clipper is used called the Sheath Clipper, one blade of which works between a sheath. An average of not over 7% of injury was found in the fruit of four different growers, the lowest percentage of this kind found in any association house. I think this is due in large part to the type of shears used, which prevents the cutting common to the pointed type of shears.

Sent out circular regarding the amount of clipper injury to Southern California Fruit Exchange, California Citrus Union, a number of independent packers and to a list of about fifty papers in the State.

March 1. At Los Angeles. Spoke to the Board of Directors of the Southern California Fruit Exchange regarding the amount of clipper cut fruit. Made suggestions regarding the way of getting this information before the patrons of the different associations.

In the afternoon at the Pasadena Lemon Growers Association.

March 2. At La Mesa Packing House, Riverside, examining fruit in series to determine effect of clipper bruising on development of decay. The following general results are secured from this test, in which many boxes of fruit were used.

Fruit free from injury,	1%	decay
" " " " and blue mold spores touched on every orange	2-7/10%	"
Clipper cut fruit from orchard run,	12-7/10%	"
" " " with spores touched on point of injury,	58-1/2%	"

This fruit stood in an open packing house twelve days. The conditions in this house were unfavorable to the development of the decay as the fruit stood in a pile by itself and was therefore subjected to much more air than is usual in a refrigerator car or where a large number of boxes are piled together.

March 3. Prepared a series of oranges at Riverside Heights No. 10 Packing House to determine the effect of careful handling, clipper cutting and brushing. This fruit is set aside to remain about two weeks before examination.

Prepared another similar series at La Mesa Packing Company's for same purpose.

March 4. Spoke before the Board of Directors of the Ontario Cucamonga Fruit Exchange at Upland on the relation of mechanical injuries to the development of decay in oranges.

March 6. At Prenda Packing House examining various series of fruit with the following general results. In most of these series not less than five boxes of fruit were used for each determination. This fruit

has remained in a temperature of about seventy degrees in moist air since February 21st.

Series I.

Fruit free from injury	1-3/10%	decay
" " " " and brushed	8-3/10%	"
" " " " " each orange covered with spores,	17-7/10%	"
Fruit clipper cut,	56%	"
" " " and brushed,	45%	"
" " " " spores applied to each orange,	81%	"
Fruit ordinary orchard run but picked carefully,	2-6/10%	"
Fruit orchard run, brushed,	8-2/10%	"
Clipper cut fruit, orchard run, with spores applied,	35-7/10%	"

This series brings out very clearly the relation of mechanical bruises to the development of decay. It brings out also the fact that the brushing apparently increases the susceptibility in the fruit that has not been injured, especially when these results are taken in connection with several others of a similar nature.

Series II.

Fruit in Warm Moist Room one Week.

Fruit free from injury,	6/10%	decay
" " " " brushed	7-9/10%	"
" " " " and spores applied,	4%	"
Clipper cut fruit,	59%	"
" " " and brushed fruit,	64%	"
" " " fruit with spores applied,	63-9/10%	"
Fruit, orchard run,	7/10%	"
" " " brushed,	7-4/10%	"
" " " " very hard,	62%	"

This series brings out very clearly again the practical immunity of fruit that is free from injury, even in a hot moist room. There are probably many small mechanical bruises on this fruit that we cannot see with the naked eye which the spores get in.

The following table brings out the relation of the boric acid treatment to the development of decay in oranges and lemons. One box of fruit was used in each of the tests. All of the fruit was first run through a washer and remained in a warm, moist room one week.

Lemons.

Spores blown over lemons,	5% decay
Shaving of skin taken off and spores blown over,	29% "
Clipper cut fruit, spores touched to injured part,	94% "
Spores blown on fruit then treated ten minutes to 3% boric acid,	1% "
Shaving of skin removed, spores blown on and then treated with boric acid,	No "
Clipper cut fruit, spores touched to injured portion, then treated with boric acid,	1% "

Oranges.

Clipper cut fruit, spores touched to injured portion,	80% decay
Clipper cut fruit, spores touched to injured portion, then treated with boric acid,	No "

There was some apparent injury from the boric acid treatment in the form of discolored brown areas where the acid evidently accumulated on the under side of the lemons and was not evaporated for sometime on account of the moist air of the room. A weaker solu-

tion will be applied and the acid will be evaporated quickly from the fruit in further tests. The treatment has apparently prevented the development of the trouble.

I desire to call attention to the development of the so-called poison rot in lemons. This trouble is very serious at the present time. The same trouble seems to be on the orange also and is apparently confined to fruit growing near the ground, as it is seen on the fruit hanging on the trees. The lemon growers especially are very much afraid of this disease, and it is one that needs the careful attention of a pathologist. In the work that we are doing it is not possible to give much attention to specific troubles of this kind, and it cannot be done until a pathologist is assigned especially to this problem. The growers are requesting help wherever we meet this difficulty, and the Directors of the Southern California Fruit Exchange asked at the meeting this week especially that the trouble be taken up by someone from the Department. It is not possible for Mr. Tenney to give very much time to the pathological features of this trouble on account of press of other work. We have asked Mr. Pierce to look at the trouble and he has promised to come to Riverside sometime the latter part of this week to examine it. In case Mr. Pierce is not able to give it attention, I would urge that some arrangement be made by which a pathologist could be assigned to this trouble in connection with our work another year.

The circular regarding clipper cut fruit seems to be well received by growers and packers throughout the orange belt. We have had this brought to our attention many times in the last few days, and those who have a good deal invested in the orange business seem to think that we are striking at the root of a good many of the shipping troubles.

I have been told by a number of people that the

railroad people are greatly pleased with our circular. Heretofore all the troubles have been charged to the railroad service, and the growers and packers have not entertained the idea that many of their troubles were the direct result of their own methods.

(Signed) G. HAROLD POWELL.

Field Investigations

Indexed

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

Vegetable Pathological and Physiological Investigations.

Ft. Valley, Ga., March 20, 1905.

Dear Mr. Powell:—

Your letter of the 8th inst. giving result of test with Boric Acid on oranges and lemons was forwarded to me here and I have sent it to Mr. Gore. Your figures are quite favorable to the treatment and I hope you may be able to make something out of it. I will be here until the first of April and if the shipment of treated fruit arrives before I return to Washington Mr. Gore will look after it. Peach trees are now in full bloom and the crop is good.

Yours etc.,

W. M. SCOTT.

Field Investigations

Riverside, Calif., Mar. 27, 1905.

Mr. W. M. Scott,
Fort Valley, Ga.

My Dear Scott:—

Your esteemed favor of the 20th inst is at hand. We have not yet been able to make any shipments of lemons

treated with boric acid on account of press of work connected with our orange shipments. I hope that we may be able to get at this within the next two or three weeks and make several shipments direct to Washington.

We find that we have more than we can look after on our orange investigations, and have not had time to give to the lemons up to date.

Very truly yours,

Pomologist in charge Fruit Storage Investigators.

Field Investigations

Indexed

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C.

Division of Foods.

Pomological Investigation. Received. Apr. 12, 1905. Answered April 12, 1905.

Mr. William Taylor,
U. S. Department of Agriculture,
Washington, D. C.

Dear Sir:—

The results of the experiments with boric acid and lemons are entered on the table which is inclosed herewith. A discussion of the results is as follows:

(1) Considerable infection from the air took place in experiments 22 and 23, no precautions being taken to prevent accession of spores before wrapping. The abrasion, type 2, showed this infection most, as might have been expected since the inner portions of the rind are most exposed by this form of abrasion.

(2) Any increase in infection by soaking in spore containing water, is masked by above noted infection from the air.

(3) The effect of boric acid is very marked on the fungus growth on this infected soaked fruit.

(4) With inoculated fruit, the most perfectly successful inoculation is with abrasion type 2, the long gash. This is also the best checked by boric acid. Type 1 is shown to be the next most readily checked type. Types 3 and 4 are the most difficult to control with boric acid, particularly type 3.

(5) No effect is shown on the inhibition of the fungus development by boric acid, due to previous soaking of the fruit or to rinsing after dipping in boric acid.

It is suggested that further experiments be carried on to further test these two points, whether previous soaking or rinsing after dipping hinders the action of boric acid on the fungus growth.

Respectfully,

H. C. GORE.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C.

H. C. G.
M. C. G.

Field Investigations
Indexed

Division of Foods.

Pomological Investigation. Received Apr. 21, 1905. Answered April 20, 1905.

Mr. William A. Taylor,
U. S. Department of Agriculture.

Dear Mr. Taylor:—

Referring to my letter of last week in regard to the boric acid experiments with lemons it will be noticed that there reference was made to experiments to be performed, repeating those experiments which give results

on the effect of previous soaking and rinsing after dipping, on the checking of the fungus growth by boric acid. Such experiments have been carried on, and the results have shown that previous soaking seriously interferes with the fungicidal effect of boric acid, but that rinsing has no such prejudicial effect upon the action of boric acid. In experiment 35 in which lemons were dipped for one hour in boric acid after 10 minutes soaking in water, it will be noticed that there was a 33% decay in abrasion type No. 2 after seven days, showing some retardation due to boric acid but not a definite checking of the fungus growth as desired. At the same time, it must be remembered that both the abrasion and the inoculation are very severe, probably much more severe than would occur in actual practice. I enclose an addition to the table sent with the letter of last week which should be filed with it.

Very truly yours,

H. C. GORE.

Enclosure:
Addition to Table.

FEB

Field Investigations
October 26, 1909.

Mr. A. D. Shamel,
Physiologist,

68 N. Los Robles St. Pasadena, Calif.

My dear Shamel:

I was in New York several days last week or would have replied earlier to your letter of the 14th instant. I spoke to Dr. Woods about the use of bicarbonate of soda for blue mould. He said it would be safe to run it at different strengths from 1 to 1000 and 1 to 200.

I will try to look up the notes and see what we did on this the first year we went to California. We had a good deal of work at Prenda and found no difficulty in

killing the blue mould with strengths that did not injure the lemons. However, we did not follow this further as I did not think it a good policy to encourage any method of retarding blue mold other than sound lemons. The work in California shows that the lemon properly handled does not decay from blue mold. We have therefore not thought it wise to develop any short-cut methods of retarding the rot, as this would shortly be followed by a letting up in the careful handling methods. We have been asked many times to work out methods of killing the blue mould in the wash water for oranges, and two years ago Dr. Wheeler was in Riverside all winter working on the effect of different fungicide on the death of penicillium. At the end of this work we were more than ever convinced that we were on the wrong track and the thing that was to be constantly driven home was the relation of a sound orange or lemon to freedom from decay. I do not see that dipping the packing boxes or spraying the houses will have any effect upon the amount of rot. A house can be pretty fully of blue mold, and so can the packing boxes, but it cannot get into a lemon that is handled properly. On the other hand, blue mould is always present in the air and in the packing houses in California and under the most sanitary conditions in the packing houses there will probably always be enough blue mould present to infect improperly handled lemons.

I wish you would think along this line somewhat from the standpoint of general policy in connection with the industry and see if you do not agree with me.

I was interested in the sketch of the lemon washer which Mr. Hampton has temporarily adopted. This seems to be somewhat of a modification of Farr's as I recollect seeing it.

I was very much interested in reading the clipping from the Hartford "Courant," in reference to the New

England Dent Corn I sent the article on Mays to Secretary Hays.

I spoke to Dr. Woods about your plan of co-operative breeding and he said that we wished you would prepare a statement of it so that it could be given to Mr. Knapp. Dr. Galloway also said that he would be only too glad to have it. I gave the "Courant" article to Galloway and he was much interested in looking it over. Both Dr. Woods and Dr. Galloway were much interested to hear of the progress you were making in California.

I suppose the boys will be coming to Washington now before long as they are about closing up the work at Lodi.

We are having beautiful fall weather, with practically no rain. I am looking for Harry Chase before long as I understand he will leave Riverside about the first of next month.

With personal regards, I remain

Yours very truly,

Pomologist in Charge of Fruit Transportation and Storage.

FEB

Field Investigations
November 8, 1909.

Mr. A. D. Shamel,
Physiologist,
68 N. Los Robles Street,
Pasadena, California.

My dear Hamel:

I have your letter of the 1st instant also the one of the 2nd. I am very much obliged to you for the data of the cost of lemon production. I shall be very glad to receive as many of these statements as you can secure.

I was very much interested in your letter of the 1st and am glad to hear that you have the experimental

work so well in hand. I have just telegraphed Pratt asking him to stay in California rather than to come east. He will look after the apple, grape, and grape inspection work, and will take hold of the lemon work just as soon as he can. Stubenrauch wrote that there would be too much for him to look after and this seemed the only practical way out of it.

I have a wire from Hosford this morning saying he has accepted the San Dimas place and will take up the work there at once.

I was interested in your remarks regarding the use of sodium carbonate solution for blue mould. I do not think there would be very much trouble in finding some of these solutions, but as I wrote you before, I think it would be distinctly detrimental to the industry if a fungicide should be adopted even to cut out decay in the scarred and bruised lemons to which you refer. There would certainly be a let-up in the practices that are fundamental in keeping the product sound if the average grower could depend upon the fungicide to overcome a definite piece of careless work. Just as soon as the grower lets up in one fundamental he always lets up in others. For that reason I have always felt like holding rigidly in California to careful handling as the only means of retarding the common blue mold. By doing so I am satisfied that it has had a splendid effect upon other operations in the lemon industry. There are some individuals who might be able to use fungicides and who would not let up, but they are few and far between. I would like to see the time come when all this weak and scarred fruit would go into by-products, just as it does in Italy. The lemon industry has been so profitable that the lemon grower has been tempted to ship all kinds of fruit.

I have no doubt but that there is a good deal in what you say about the fertilizer question. I wrote

you about it a few days ago. We are still receiving letters from some of the associations and growers, and letters have just come in from Mr. Teague asking that Dr. Briggs be sent there preliminary to taking up the question. I hardly think that Dr. Galloway will consider this wise, as it would not pay to open the question unless it could be followed up. Briggs has no money to carry on this work and Dr. Galloway and Dr. Woods both feel that the responsibility for work of that kind must be placed upon the University people. If they have not the right kind of men it is up to them to secure them.

It will be necessary in the future even more than it has been in the past not to encourage the growers to ask the Department to solve the different problems that come up. They naturally look to the Department to help them out on account of the Department work having been productive of good cash returns. If the University does not improve its equipment along these lines then we will attempt to organize a soil maintenance problem, using several specialists, physiologists, pathologists, pomologists, chemists, bacteriologists and any others that are needed. It will not be done by putting in one man on it, but by co-ordinating the work of several of our best specialists. There has been a good deal of orchard work in the country done by the chemists and by other workers, but none of it has thrown any light on the fundamental principles of orchard maintenance. We are thinking about this a good deal and I think that within the next year or two we will try to launch a soil maintenance and orchard maintenance problem. Probably the conditions in So. California may be more advantageous than those in any other section for carrying on this work. If the University has not braced up in its soil work by that time we certainly cannot be criticised if the problem is taken up there. In the meantime we had better do all we can

to throw all problems toward the University. I enclose another letter relating to it.

Your remark from Harwood that he was selling his low grade fruit at $2000 a car makes me wonder if this will average more than four per cent on the industry.

Your remarks regarding the curing question are also very interesting. This work evidently needs some reorganizing. Of course the only thing we can do is to let the curing side alone and give True's men a free field. You are undoubtedly bringing about the changes that are necessary to improve the curing without actually taking the work up.

I would be very glad to see the plans regarding the orchard work as soon as you have time to reach them. I should think it would be well to go pretty slow about selecting many plots the first year. Probably if you did not select more than one or two places it would give you an opportunity to become still further acquainted with the problem and then you would be in better condition to make a final selection of the places. If you take the Eureka Ranch as one place and a lemon grove somewhere it would possibly give you all that you would care to undertake the first season. There will be a great deal of interest in that line of work after you have undertaken it.

I will talk with Fairchild about the citrus fruit stocks, and I will see that Harry Chase comes in contact with Carner when he reaches here.

Ramsey arrived a couple of days ago, and Tenny leaves for Florida this week. Ramsey will go to Florida in about a week.

Everything here is going well.

With kindest regards, I am,

Yours very truly,

G. H. P.

Pomologist in Charge of Fruit Transportation and Storage.